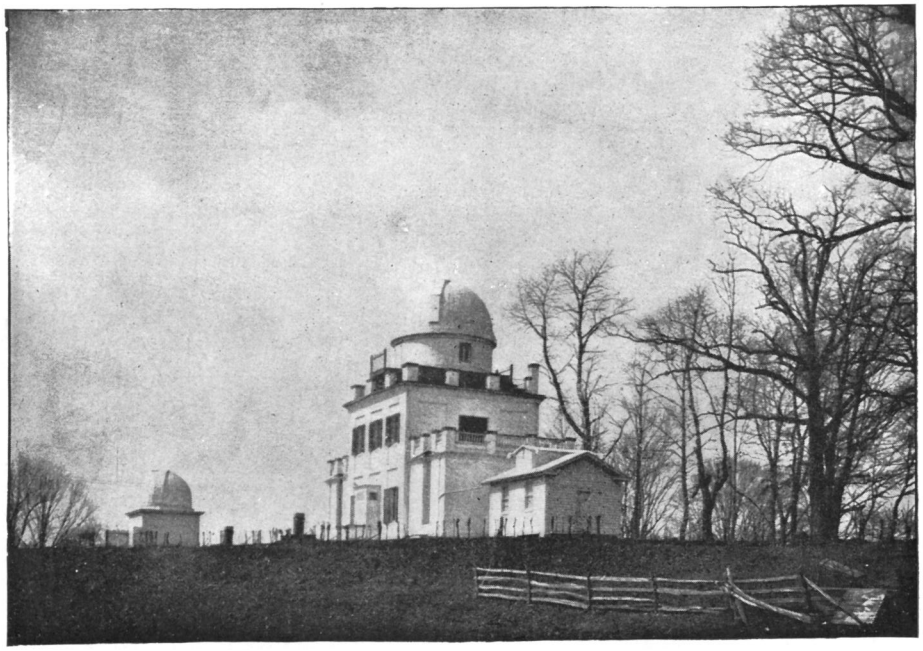


OBSERVATORY OF GEORGETOWN COLLEGE.

GEORGETOWN COLLEGE OBSERVATORY, 1843–1893.

By G. A. Fargis, S. J.

In 1841, the Faculty of Georgetown College decided to erect and equip an observatory, in which practical instruction in astronomical work could be given to such students as showed any aptitude or inclination for this particular branch. As the undertaking was chiefly the suggestion of the late Rev. James Curley, S. J., at that time Professor of Physics at the College, to him was entrusted the duty of choosing a convenient site and preparing plans for building and equipment. An elevated spot, about 400 yards almost due west of the College buildings, was judged to combine various advantages of situation and seclusion. It is on a hill about 150 feet above the level of high tide of the Potomac river, which runs due east, at a distance of almost half a mile. The slope on all sides, save to the north, is quite abrupt, and the view, especially to the southeast, is remarkably fine.

The plans for the buildings were made and the first instrument ordered in the year 1841; the excavations were begun in 1843, and, three years later, the first observations were made. The building is 60 feet long from east to west and 30 feet wide. The middle portion is 30 feet square, two stories in brick, surmounted by a third in framework, capped by a rotary dome 20 feet in diameter.

The east and west rooms, which contain the meridian instruments, have meridian openings 2 feet wide in the roofs, continued down the north and south walls to within 2 feet of the ground. In the west room is the transit instrument by Ertel & Son, of Munich, mounted in 1844. The objective is 4.5 inches aperture, with a focal length of 6.5 feet, and has four eye-pieces, giving powers from 80 to 200. There was also in this room a good sidereal clock, by Molyneux, of London.

In the east room, mounted on two very massive piers, is a 45-inch meridian-circle, made by Troughton & Simms, of London, in 1845. It is graduated on silver to 5-minute divisions, reading by four microscopes to fractions of a second, and has a lens of 4 inches aperture. This room also contained a fine Molyneux sidereal clock.

In the center of the main building, passing through the three

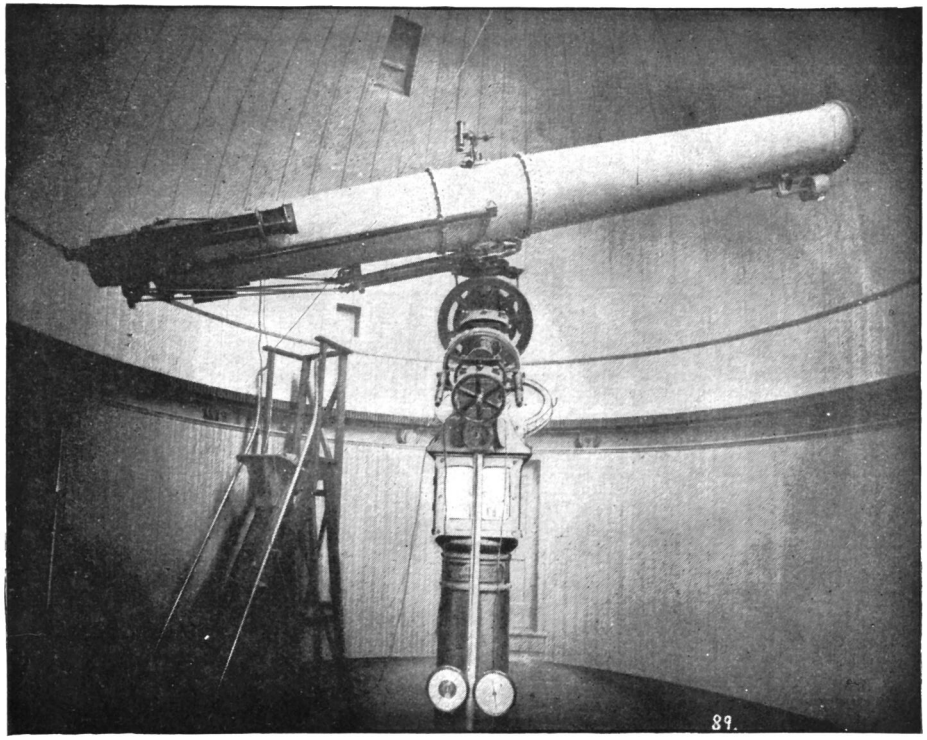
floors, rises a pier of masonry 41 feet high, 11 feet square at the base, and 4 feet square at the top. It does not taper like a pyramid, but at every 7 feet in height it diminishes at once 5 inches all around; hence, its lateral surface is always vertical, but it has an offset in each room.

At its entrance to the dome-room, the pier is capped with freestone 10 inches thick, and on it was mounted in 1849 an equatorial telescope by TROUGHTON & SIMMS, of London. The object glass is nearly 5 inches clear aperture and about 80 inches focal length, with eye-pieces affording powers from 25 to 400 diameters. The declination-circle is 20 inches in diameter, reading by 2 verniers to 5 seconds. The equatorial-circle is 16 inches in diameter, and reads to 1 second of time. The instrument was fitted with a driving-clock and a 1.5 inches finder of 13 inches focal length.

There were also two 3-inch refractors; a 10-inch reflecting-circle; a universal, or altitude and azimuth instrument, reading to 10 seconds, by ERTEL & SON, of Munich; a mean-time and a sidereal-time chronometer, and an arc of reflexion of 5°, with a radius of 22 inches, by TROUGHTON & SIMMS. A library was formed, consisting of some 500 volumes, and it at present contains the publications of nearly all the observatories and astronomical societies of the world.

The expenses of building and equipment were defrayed for the most part by donations from the Rev. THOMAS MEREDITH JENKINS, S. J., and the Rev. CHARLES H. STONESTREET, S. J., at that time Professors at Georgetown. The building of the observatory and the mounting of the instruments were superintended by the first Director, the Rev. JAMES CURLEY, S. J. He determined the geographical position of the observatory in 1846 —the longitude $+ 5^h\ 8^m\ 18.29^s$, by corresponding observations of moon-culminations at Georgetown and Greenwich; the latitude 38° 54′ 26″.2, by upper and lower culminations of circumpolar stars.

The political disturbances in Europe brought several Italian Jesuit scientists to Georgetown, among whom were the three Jesuits, DE VICO, SECCHI, and SESTINI. The first mentioned was soon recalled to England, where he died November 15, 1848, at the age of forty-three. There is still preserved at Georgetown the gold medal which he received from the King of Denmark, for his discovery of six comets (I. 1844; II. 1847;



TWELVE-INCH EQUATORIAL OF GEORGETOWN COLLEGE.

I. V. VI. IX. 1846), while Director of the Observatory at the Roman College. He was a member of the Royal Astronomical Society of London.

Father SECCHI, then thirty years of age, taught physics for a year at Georgetown, and returned to Rome to enter on his career in physical astronomy; but his first interest in this study dates from the observations he made with Father CURLEY at Georgetown.

Father SESTINI began observations of star-colors in 1849, the manuscript of which is preserved in the library of the observatory. In 1850, he made drawings of Sun-spots from September 20th to November 6th, missing but 6 days out of 48. The drawings were lithographed, and together with a journal and preface, were published in the appendix of the Washington Astronomical Observations for 1847. A set of copies is still in the library of the observatory.

In 1852, a volume of 215 pages in quarto, containing a description of the observatory, with 8 plates and reduction-tables for time observations, was published and distributed by the Director. But the regular publication of astronomical work, nay, even that work itself, was found incompatible with the prosecution of the main design in founding the observatory, viz: the instruction of the students in the use of fine astronomical instruments. Hence, the first volume of the "Annals of Georgetown College Observatory," was also the last. Thus, for nearly half a century, Georgetown Observatory was little more than an adjunct to the physical laboratory and class-room, but in 1888, on the eve of the centennial celebration of the founding of the College, the Directors of the University decided to put a younger man at the head of affairs; to place a liberal allowance at his disposal, and to do everything necessary to bring into existence a practical working observatory; and so, the venerable Father CURLEY, at that time ninety-two years of age, resigned his honors and his responsibilities into the hands of the Rev. JOHN G. HAGEN, S. J., the present Director. Professor HAGEN is well known in mathematical circles as the author of a work entitled, "A Synopsis of Higher Mathematics," which is in course of publication in 4 quarto volumes. Two of these have already appeared and have been favorably received by the mathematical world.

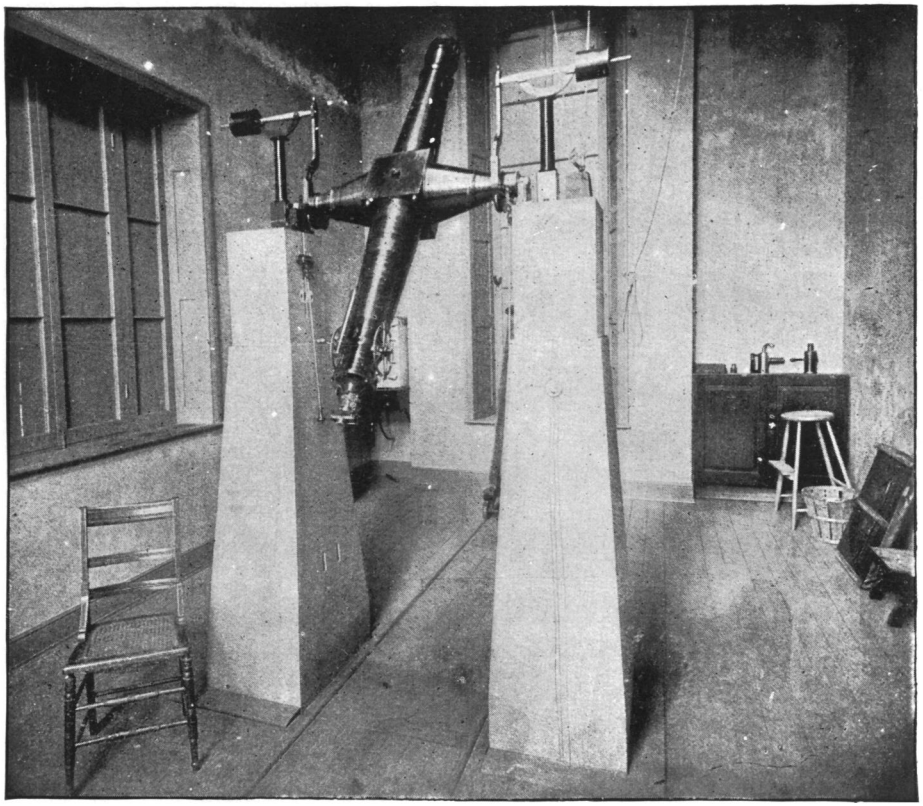
The rehabilitation of the observatory was necessarily slow, for want of funds. The entire establishment and some of the instru-

ments had suffered not a little from dampness and neglect, and a considerable sum of money had to be expended for repairs of the building, drying and heating the cellars, painting, etc. All the instruments were dismounted and thoroughly overhauled. The equatorial received a helioscope. One of the 3-inch glasses was mounted as a portable equatorial, and another as a comet-seeker. The clocks were carefully gone over and removed to the middle room of the first floor, where the temperature could be properly controlled. They were attached to the equatorial pier, enclosed in double glass cases and provided with the GARDNER electric spring contact. A new chronograph, by FAUTH & Co., of Washington, was placed between them.

A triple electric-wire system was run to a switchboard in the clock-room, one making connection with the U. S. Naval Observatory, another connecting the clocks and observing keys with the chronograph, and a third affording incandescent illumination for the field and the reading microscopes of the equatorial and meridian instruments. The arrangement of the switchboard is due to Dr. WILLIAM C. WINLOCK, at that time Assistant Observer at the U. S. Naval Observatory, and is similar to that in use at the observatories of Harvard College and Mount Hamilton, Cal. Two substantial brick piers, capped with free-stone, were erected to the south of the main building, one in front of either wing, for use with collimators and portable instruments; they were provided with electrical connections for the chronograph, clocks, and incandescent lighting.

As a suitable field of work for the 5-inch equatorial, now in good condition, the Director chose *Stellar Photometry*, leaving all routine work, observations of planets, double stars, nebulæ, etc., to fully manned and better equipped establishments. The results have appeared on various occasions during the past six years in the "Astronomical Journal." The same instrument was afterwards devoted to a regular and systematic determination of the relative brightness of all the stars in the neighborhood of some of the most interesting objects in the sky.

These signs of awakened vitality soon aroused the interest of the friends of the observatory, and their zeal took the practical shape of donations, amounting in all to $20,000, part of which was destined for the construction of a 12-inch equatorial. For the reception of this new instrument, the dome had to be partly remodeled and elevated, and the 5-inch equatorial was installed



TRANSIT INSTRUMENT OF GEORGETOWN COLLEGE.

in a 12-foot dome, erected on the grounds a little to the southwest of the west transit-room.

Circumstances conspired at this juncture to focus the Director's attention on photographic meridian observations, and the ERTEL transit was thoroughly fitted up for the purpose, and intrusted to Professor G. A. FARGIS, S. J. The outcome of these investigations was dubbed the "Photochronograph." This device attached to the eye-end of the transit instrument and connected electrically with a sidereal clock, records automatically on a sensitive plate the exact time of the passage of a star across the meridian; and, in such fashion, that while it eliminates personal equation, it introduces no new instrumental error.

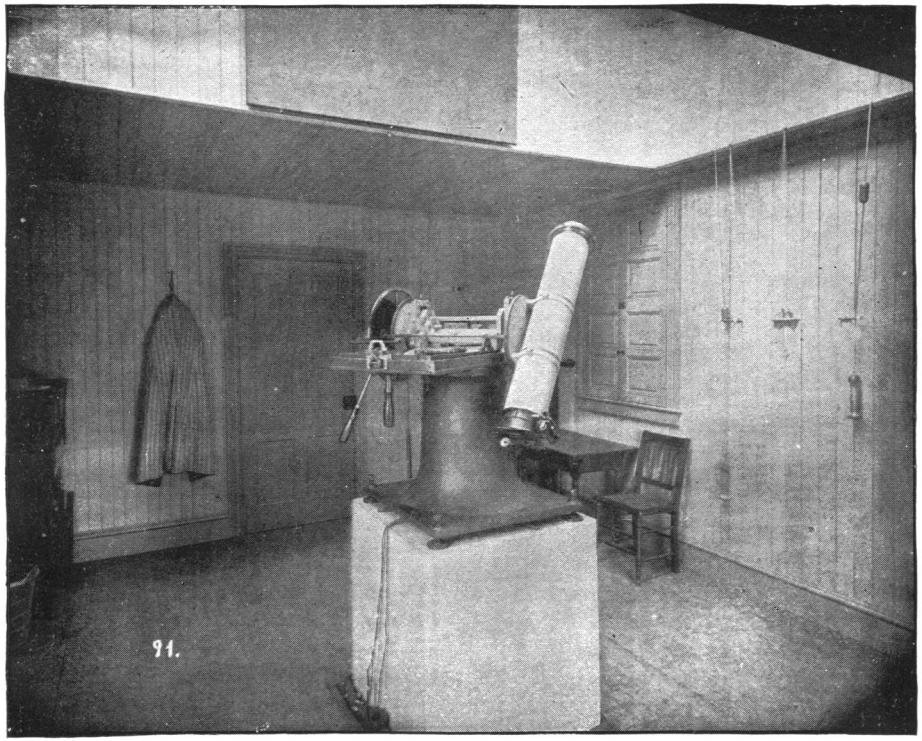
The photochronograph designed by Professor FARGIS, and constructed by Mr. G. N. SAEGMULLER, of Washington, was set to work October 3, 1890, and thenceforward, until June 29, 1892, —127 nights in all,—the method was rigorously tested. Over 3000 photographic transits were secured, and more than a quarter of a million micrometric measures of the plates made with a microscope designed for the purpose. The results, comprising some 1800 folio pages of manuscript, were confided to the care of Professor JOHN T. HEDRICK, S. J., who joined the observatory staff in June, 1891. The whole mass of material has been carefully studied, and the results are now in shape for the press, and will appear shortly in a separate publication. Thus, the scientific world will be enabled to pass competent judgment on the advantages and disadvantages of this new departure in astronomical work. A full description of the photochronograph and its practical working, with some preliminary results, was published and distributed in February, 1891.

It was the intention of the Director from the very start to study the laws of polar variation by means of photography. Various methods for the determination of latitudes and their periodic variations had been repeatedly pronounced highly desirable and quite feasible; but a practical method, embracing all the advantages of existing methods, and capable of putting the whole record graphically on the sensitive plate, had not hitherto been suggested. It was determined from the outset, that the spirit-level should be replaced by mercury, and early in 1891, the *floating* principle was adopted, but the plan remained incomplete until Professor FARGIS suggested the application of the photochronograph.

In August, 1891, the order was given for the "*Floating Zenith Telescope.*" It had a 6-inch photographic combination of lenses by BRASHEAR, of 35 inches focal length, with a specially constructed double-bar photochronograph; the whole roughly mounted on a float resting in a bath of mercury, and maintaining, in consequence, a constant level. In May, 1892, a complete and successful set of photographic latitude determinations, without the use of the spirit-level, were made and the results published and distributed as before. For the proper housing of this instrument, a frame building, 12 by 14 feet and 18 feet high, was erected to the east of the east transit-room, and was fitted with accessories, such as clocks, electric lights, etc.

Rev. JOSÉ ALGUÉ, S. J., the present Director of the observatory at Manila, Philippine Islands, and at this time engaged in special astronomical work at the Georgetown Observatory, encouraged by the success of the floating zenith telescope, undertook a series of experiments to test the merits of the *reflecting* principle. His efforts were crowned with success, and resulted in a new adaptation of the photochronograph, and the invention of a new instrument called the "*Reflecting Zenith Telescope.*" It consists of two photographic objectives, each of 4 inches aperture, placed at either end of a tube twice their focal length; the sensitive plate and disk-photochronograph being placed midway between the objectives, where the focal points meet. Thus, the light of one star of a latitude pair comes directly through one of the objectives to the sensitive plate; while the light of the other is first reflected from a suitably placed basin of mercury, through the second lens, to the same plate. The first successful observations were made in April, 1893, and a description of the instrument, its practical workings, and the preliminary results were published and distributed in June, 1893. This instrument was shortly afterwards dismounted and shipped to Manila, where it is now being used in connection with Georgetown Observatory, in studying the laws of polar variation.

These two methods eliminated the spirit-level, but others still were available. For instance, RÖMER, about two centuries ago, constructed an instrument, which he called the "Perpendiculum," and it was the intention of the Georgetown staff to utilize it as a "*Hanging Zenith Telescope,*" substituting a sensitive plate for the wire system at the eye-end. But the large outlay required for the careful construction of an instrument of this description,



FLOATING ZENITH TELESCOPE OF GEORGETOWN COLLEGE.

in order to secure results comparable with those of the instruments just described, caused the abandonment of the design.

Yet it was clearly necessary to test the visual and photographic methods of latitude determinations on more equal terms. Accordingly, in the early summer of 1893, a series of experiments was made with an ordinary zenith telescope of 3 inches aperture, in which the micrometer was replaced by a plate-holder and the usual latitude levels retained. The results were sufficiently satisfactory to warrant the construction of an instrument of this class, specially adapted to photography. The realization of the plans was intrusted to Mr. G. N. SAEGMULLER, of Washington. The completed instrument was mounted early in September, 1893, and the first latitude observations were made October 14, 1893. A full account was published and distributed in December, 1893. This "*Photographic Zenith Telescope*," furnished with a suitable photochronograph, was mounted on the pier built for the floating zenith telescope, which had to be laid aside until ampler accommodations could be secured. The 6-inch photographic lens of this latter instrument was utilized in the new one, which cost, notwithstanding, over $1,000. Regular series of observations are now in progress and the results will be made public as fast as material accumulates and the proper reductions can be made. It will be noticed, therefore, that the members of the staff of this observatory have successfully applied three new methods for the photographic determination of latitudes, each one exhibiting an important application of the photochronograph, which, in this case, may be said to have fairly covered the field.

The 12-inch equatorial was not ready for work until March, 1893. The optical work is by Mr. JOHN CLACEY, and the mounting by Mr. G. N. SAEGMULLER, both of Washington. The lenses are of 12 inches clear aperture, with a focal length of about 15 feet. A third lens is used in connection with these, as a photographic corrector, which reduces the focal length by about 10 inches. They have given complete satisfaction, and the photographic combination, in particular, has successfully withstood some very severe tests. The mounting is first-class in every respect, and the motions are easy and accurate. It has a 4-inch finder, a fine driving-clock, reading-circles—coarse and fine,—with the clamps and slow motion screws for Right Ascension and Declination at the eye-end, and is furnished with a complete system of incandescent illumination. A very interesting series of

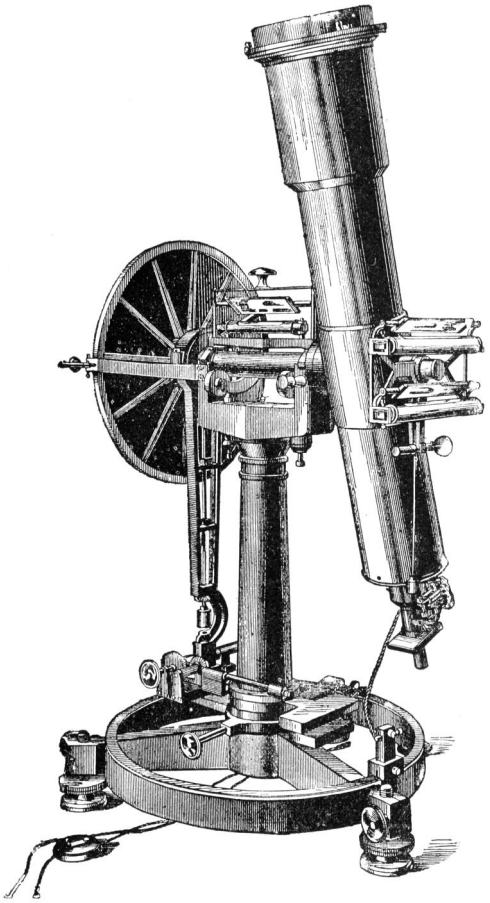
observations was at once undertaken, and a new photographic method of studying double stars, planets and satellites, was successfully inaugurated. In this method, the photochronograph again plays the principal part, and, as appears from the measures under the micrometer microscope, the accuracy attained is greater than that reached in the visual method. An extended account of the method and preliminary results was published and distributed in January, 1894.

As it was impossible for the observatory staff to exhaust the whole photochronographic field by actual experiment, a sixth publication was issued, in which further applications of this instrument were suggested, and its bearing on the subject of personal equation thoroughly examined and criticised.

The six publications issued from the observatory during the years 1891–1894 have been collected into one volume under the title: "*The Photochronograph and its Applications.*" The next publication, almost ready for the press, gives a full account of the series of photographic transits previously mentioned. The study of these very satisfactory results has determined in no small degree the character of the future work of this observatory, and orders have already been given for the construction of a first-class photographic transit instrument, the first of its kind. The objective will be of 9 inches clear aperture and of extremely short focal length, and the mounting will be such as to be perfectly responsive to the severest demands on its stability and accuracy. It is confidently expected that it will be installed and in perfect working order before the end of 1896. It will occupy the place of the ERTEL transit, which will be disposed of, to make room for the more modern instrument. With it a fundamental catalogue of the Right Ascensions of all the stars within its grasp will be undertaken, and with it the instrumental equipment of the observatory may, at last, be considered complete.

The regular work of the 12-inch equatorial is, however, visual, and not photographic. It is with this instrument that the present Director extends and completes the photometric work carried on with the 5-inch equatorial during the past 5 years. Other celestial phenomena of exceptional interest, such as eclipses, star-showers, the new star in *Auriga*, etc., have been observed, and the results published in various astronomical journals.

The plan for the future work at the Georgetown College



PHOTOGRAPHIC ZENITH TELESCOPE OF GEORGETOWN COLLEGE.

Observatory, and the one now actually in operation, includes: (1) the photometric work with the 12-inch and 5-inch equatorials; (2) the determination of fundamental Right Ascensions with the new 9-inch photographic transit instrument; (3) the study of the variations of the polar axis, with the 6-inch photographic zenith telescope; (4) the determination of the positions of double stars and *Jupiter's* satellites, according to the photochronographic method, with the 12-inch equatorial. As an earnest of the faithfulness with which this programme is being carried out, it may be mentioned that the material for 9 new volumes is in preparation for publication.

THE STORM OF JANUARY 15, 1895, AT MOUNT HAMILTON.

By C. D. Perrine.

The storm which began on January 15th and lasted until the 23d was one of the severest in the history of the Observatory. In point of duration and intensity combined, it exceeded any previous ones, and the snowfall was about equal to the heavy one of February, 1890. The barometric pressure was the lowest on record, with but one exception — namely, that of February 23, 1891.

The barographic record of the recent storm is unusually interesting. The first indications of the approach of a storm were to be noticed on the night of January 10th, when the pressure, though still above normal, became unsteady. This unsteadiness increased during the next sixty hours, the pressure all this time remaining above the normal. At 2 P. M., on January 13th, the mercury began falling slowly but steadily, until 10:45 A.M., on the 15th, when it had reached 25.370 inches, a point at which very heavy storms are usually experienced. Here it began to fall with unusual rapidity until 10:30 P. M., when a series of very rapid and sharp variations set in, which culminated at 1:45 A.M., on the 16th, at 25.060 inches. The pressure fluctuated within about 0.10 inch of this point for a full day, and then rose slightly, and for the next three days ranged about